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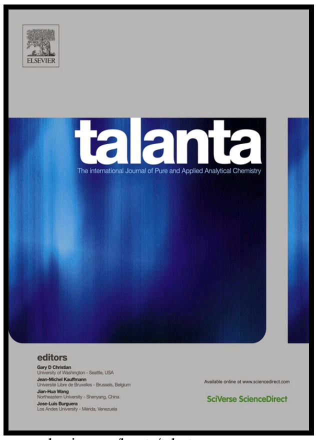

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Trace Detection and Photothermal Spectral Characterization by a Tuneable Thermal Lens Spectrometer with White-Light Excitation

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Abstract

In the thermal lens experimental set-up we replaced the commonly employed pump laser by a halogen lamp, combined with an interference filter, providing a tuneable, nearly monochromatic pump source over the range of wavelengths 430 - 710 nm. Counter-propagating pump and probe beams are used and a 1 mm path-length sample cell together with the interference filter makes an optical cavity, providing amplification of the thermal lens signal, which leads to enhancement of the measurement sensitivity, and enables detection of absorbances on the order of 5×10^{-6}. Amplified thermal lens signal allows us to replace the typical lock-in amplifier and digital oscilloscope with a silicon photodetector, Arduino board, and a personal computer, offering the possibility for a compact, robust and portable device, useful for in-field absorption measurements in low concentration or weakly absorbing species. The use of a white light source for optical pumping, an interference filter for wavelength selection and direct diagnostic of the thermal lens signal increase the versatility of the instrument and simplifies substantially the experimental setup. Determination of Fe(II) concentrations at parts per billion levels was performed by the described white-light thermal lens spectrophotometer and the absorption spectrum for 50 µg/L Fe(II)-1,10-phenanthroline was well reproduced with an average measurement precision of 4 %. The obtained limits of detection and quantitation of Fe(II) determination at 510 nm are 3 μgL^{-1} and 11 μgL^{-1}, respectively. The calibration curve was linear in the concentration range of LOQ-500 μgL^{-1} with reproducibility between 2-6%, confirming that this instrument provides good spectrometric capabilities such as high sensitivity, tuneability and